ISAW: Recent Progress on Event Data Handling and Lessons Learned

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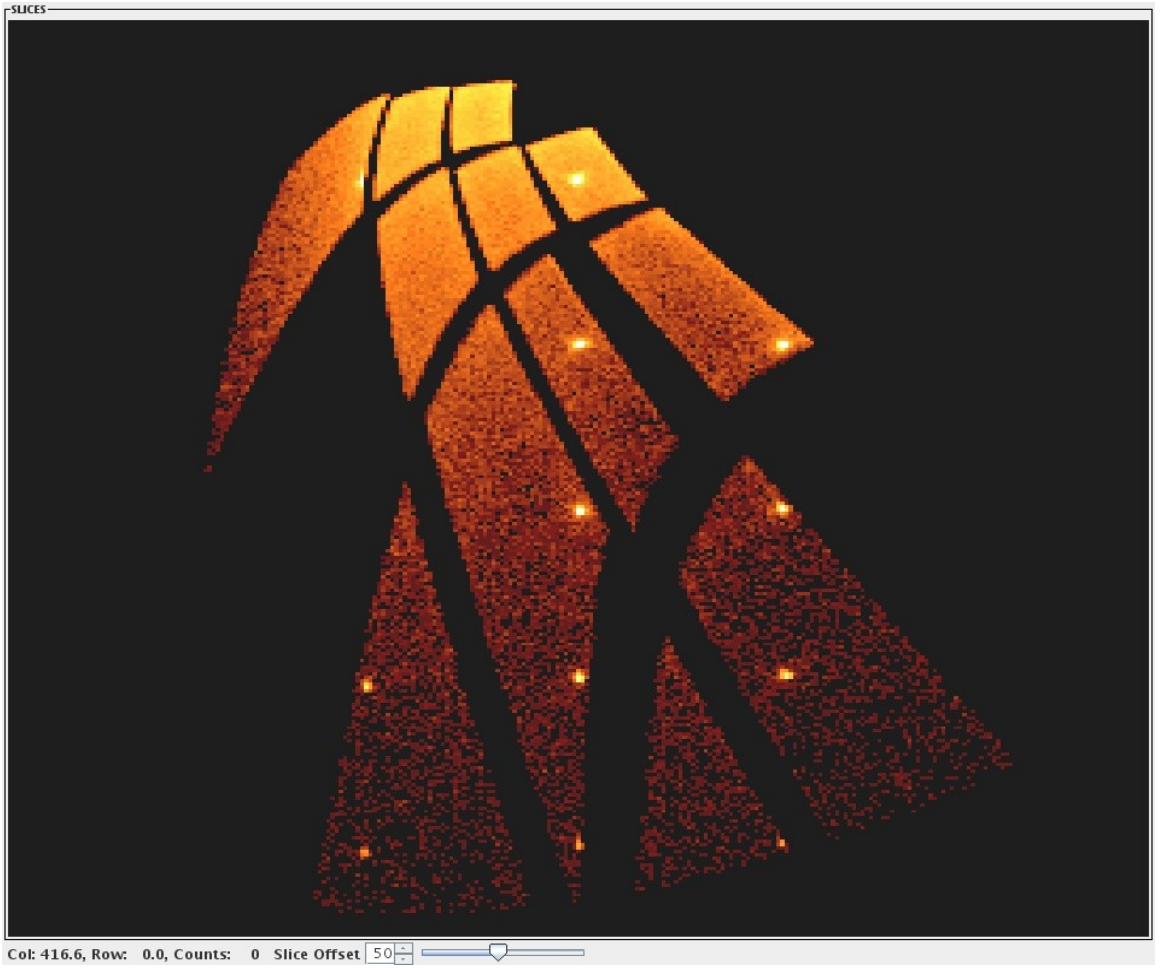


NOBUGS 2010, Gatlinburg, TN

SNS Raw Event Data

Simple file with 8-bytes per event

4-byte integer time-of-flight (100 ns)

4-byte integer pixel id

Data saved in simple binary file

Data sent out on local network

Advantages of Event Data

Conventional histogrammed data often must be rebinned
-no correct way to rebin

Event data can be easily histogrammed & re-histogrammed to whatever set of bins are needed. NO RE-BINNING.

Event data can be easily binned in whatever space is ultimately required, "d", |Q|, (Qx,Qy,Qz), wavelength, etc.

Simple raw event data file format can be streamed from disk very rapidly (roughly 10s of millions events per second)

Preserves full resolution of the acquired data
(equivalent to 160,000 time bins for 60 Hz source)

Live data format at the SNS is same as raw event data file, so can easily handle live data

Simple Event Mapping Strategy

Build tables of mapping information with
one entry per pixel

Mapping tables for d, |Q|, (Qx,Qy,Qz), wavelength, etc

For each event, use pixel id as index into mapping table,
and use time of flight to get actual value

Requires just a few floating point operations per event

Same underlying class used both for powder and single
crystal diffraction

PG3 / SNAP Powder Experiments

Map each time-of-flight event directly to “d”

Use either "d-space map file" or instrument geometry information

Time-focusing done "automatically" since conversion to d done with different constants for each pixel

Can also map to (Qx, Qy, Qz), wavelength, |Q|, etc

Fast: More than 50 million events per second using four Cores with data in disk cache

Limited by disk access time

Operator to Map Raw Events to “d”

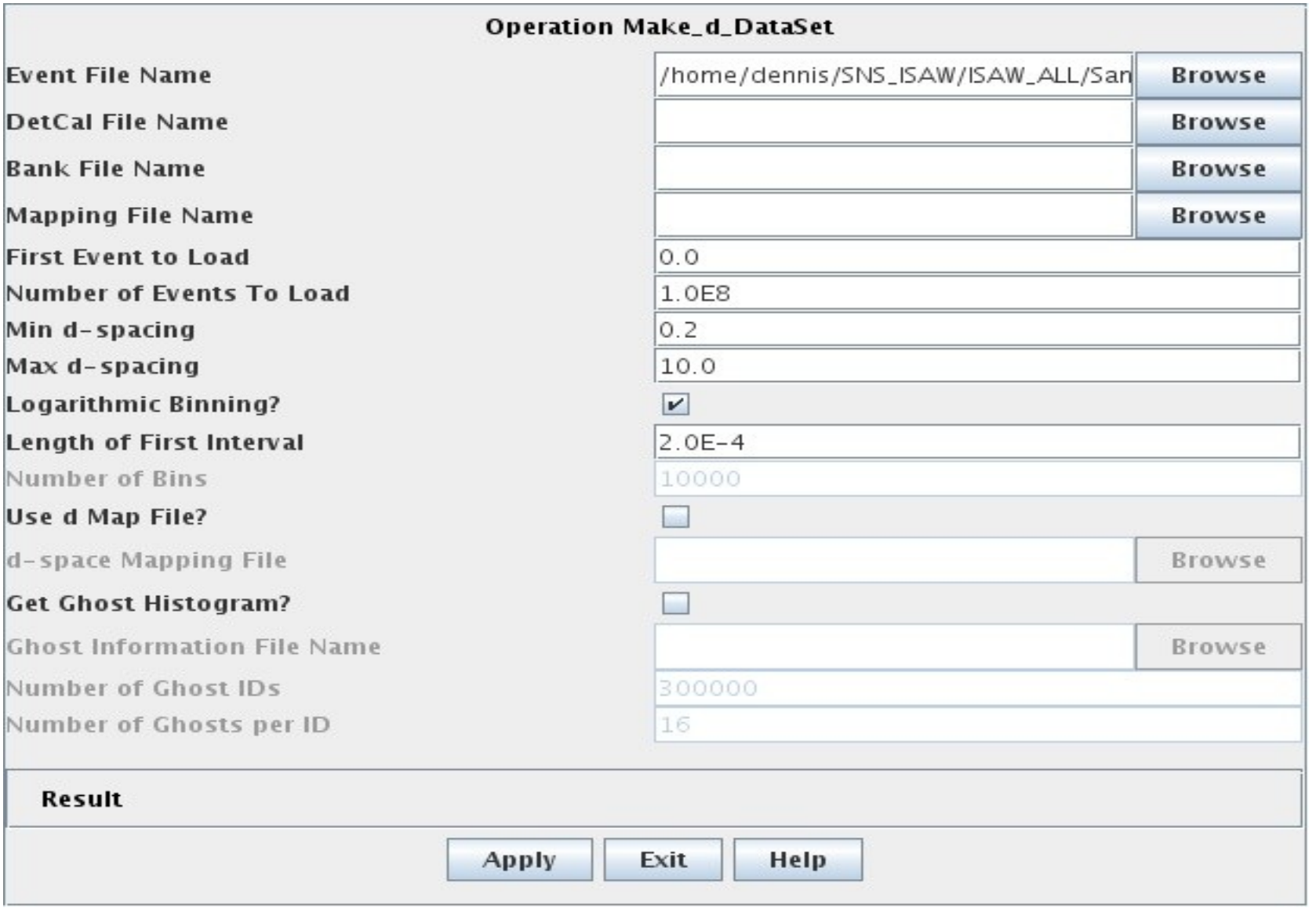
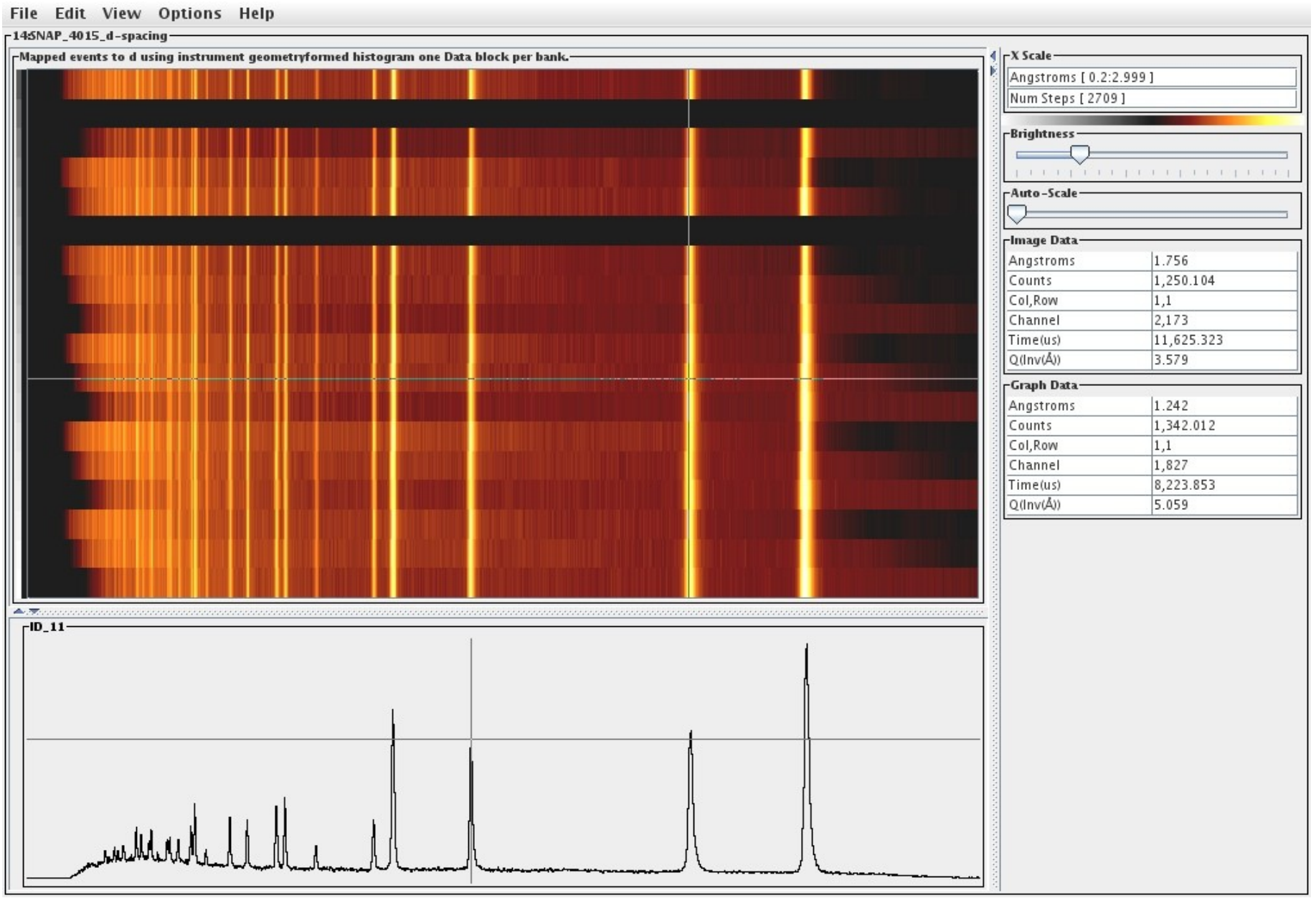
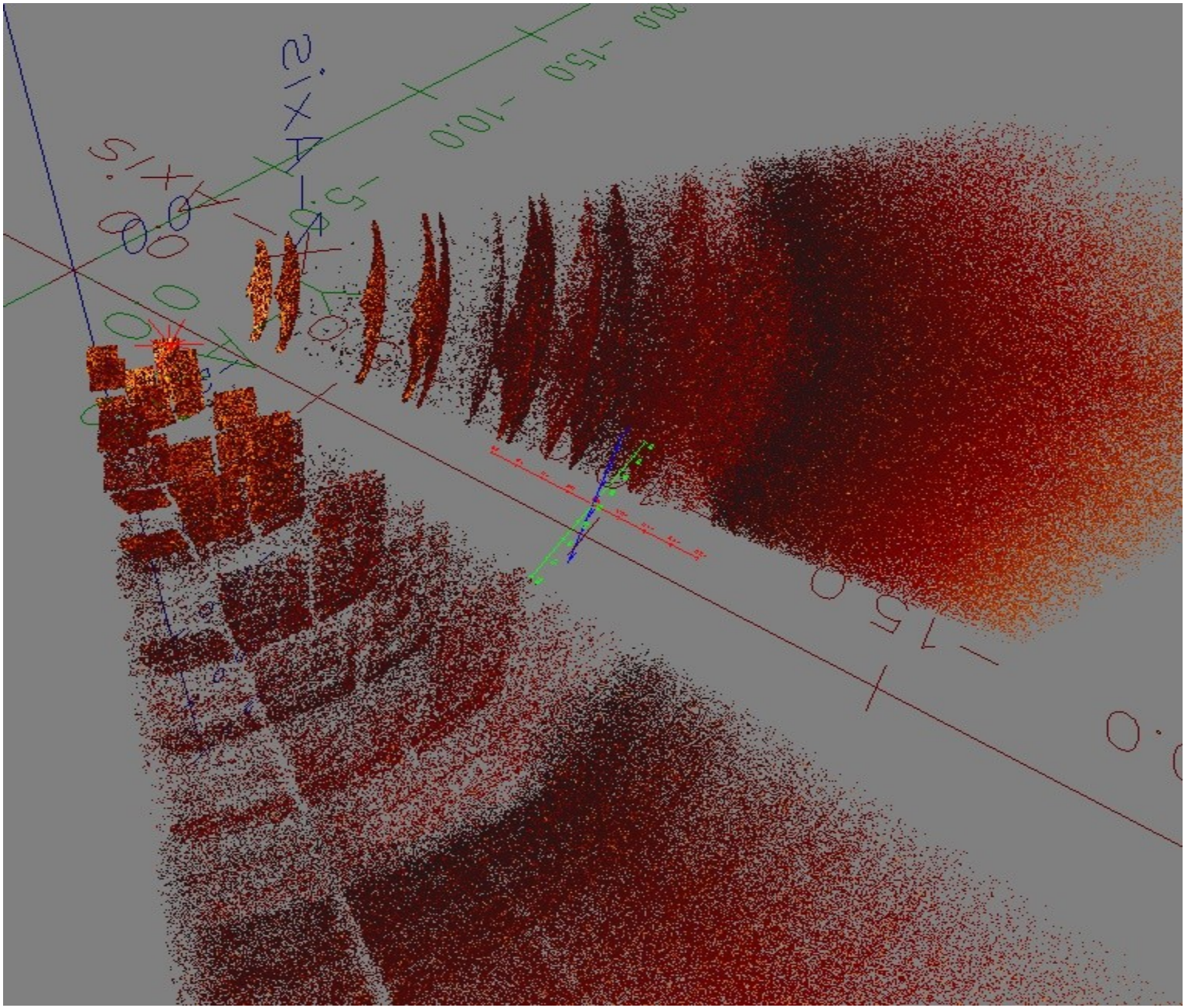


Image View of SNAP Data, 18 Banks, 1.18 million Pixels



SNAP Powder Data Mapped to Reciprocal Space



IsawEV

Built on same underlying classes as powder data reduction

Maps events to (Qx, Qy, Qz)

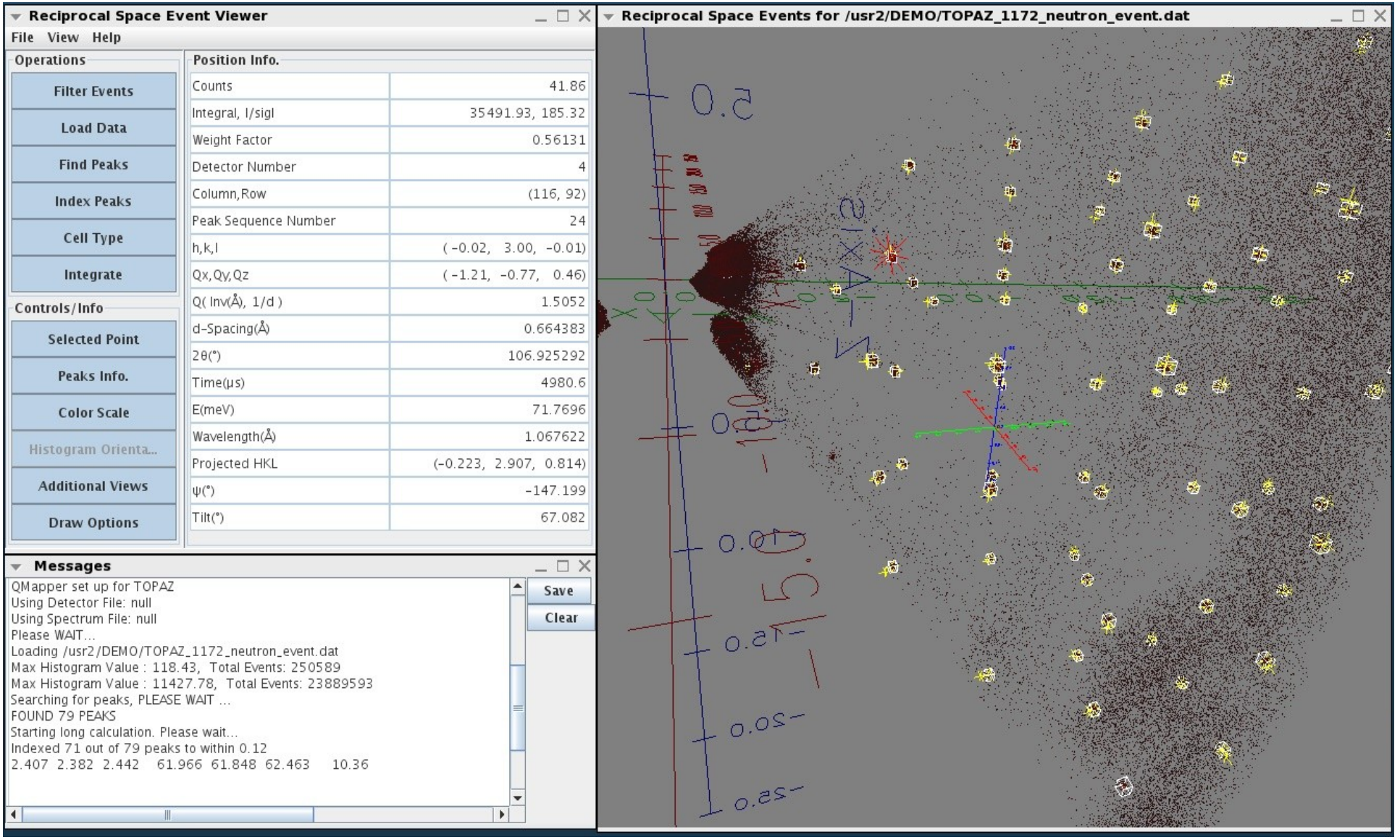
Provides scatter plot of events in reciprocal space

Uses flexible underlying histogram that can be aligned with the reciprocal lattice

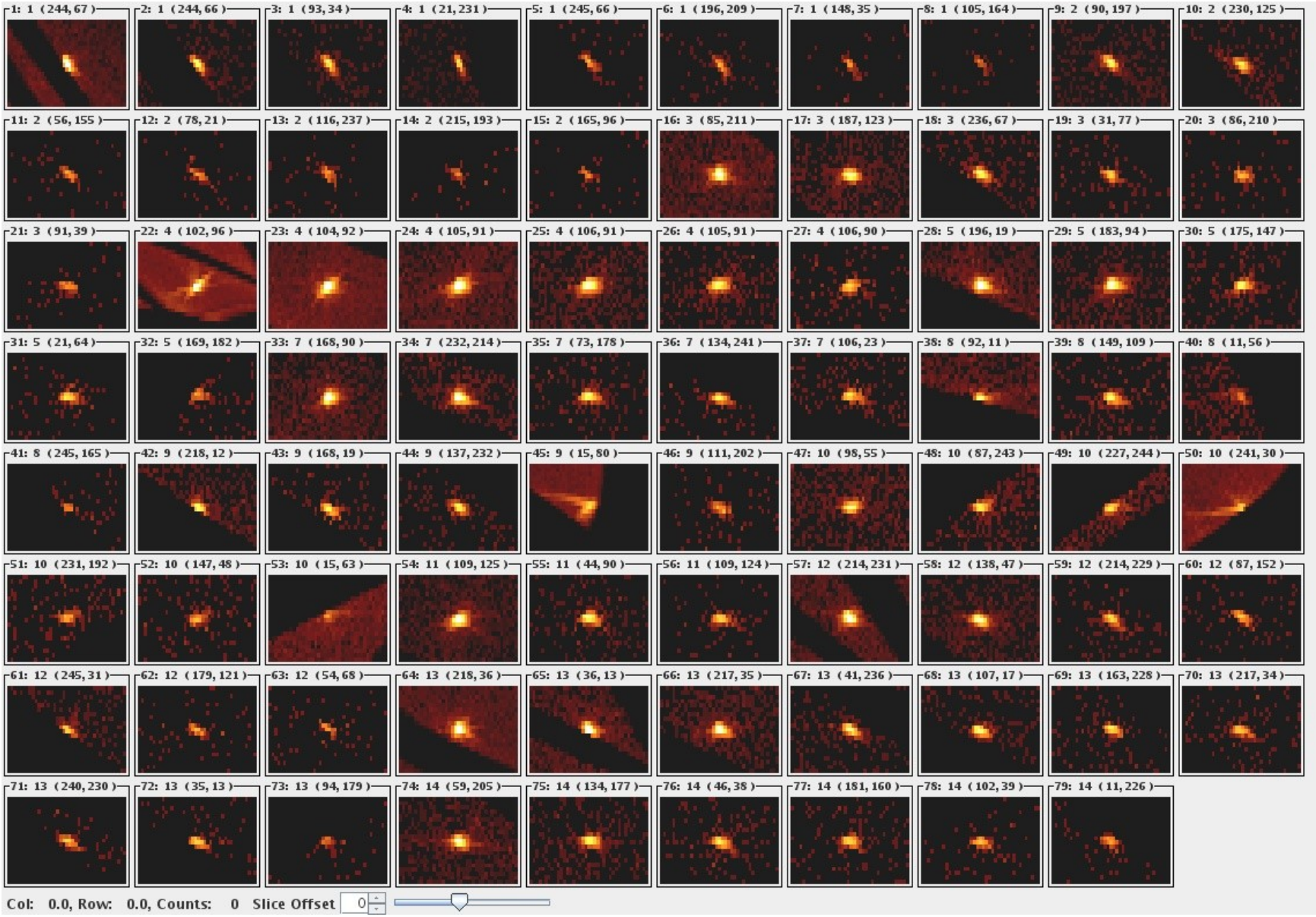
Supports SCD Initial Data Reduction
find peaks, index peaks, choose conventional cell, integrate Peaks, write peaks file

Export of slices of reciprocal space (in progress)

IsawEV Reciprocal Space Viewer / SCD Data



IsawEV Display of Peaks Found



Part of Integrated Peaks File from IsawEV

```
0 NRUN DETNUM    CHI    PHI  OMEGA MONCNT
1 1172      1  45.00  20.00 120.00 100000
2   SEQN    H    K    L     COL     ROW    CHAN       L2  2_THETA       AZ       WL        D   IPK      INTI   SIGI RFLG
3      1   -0    2    2  244.05   67.22  443.08   40.318  0.82310  3.06130  0.950315   1.1878  5297  76914.20 272.43  500
3      2   -0    4    4  244.99   66.01  223.18   40.336  0.82536  3.06191  0.477598   0.5954   345   3642.62  59.31  500
3      3   -1    5    3   93.03   34.01  182.91   39.989  0.70561 -2.92084  0.391111   0.5660   334   2297.59  46.80  500
3      4    0    0    0   21.49  231.19  139.25   40.549  0.40041 -3.12963  0.297155   0.7471   203   2071.43  44.46  500
3      5   -0    6    6  245.09   66.00  149.23   40.337  0.82548  3.06178  0.318647   0.3972    93    314.92  17.13  500
3      6    0    0    0  196.81  209.18  134.21   40.037  0.63324  2.86323  0.286392   0.4599    80    436.72  20.07  500
3      7   -1    7    5  148.02   35.21  133.20   39.937  0.75594 -3.02367  0.284244   0.3851    49    206.91  13.60  500
3      8   -1    5    5  105.58  164.56  122.09   39.588  0.56334  3.11442  0.260394   0.4684    32    219.52  14.14  500
0 NRUN DETNUM    CHI    PHI  OMEGA MONCNT
1 1172      2  45.00  20.00 120.00 100000
2   SEQN    H    K    L     COL     ROW    CHAN       L2  2_THETA       AZ       WL        D   IPK      INTI   SIGI RFLG
3      9    1    3    5   90.67  197.87  225.77   42.780  0.87018  2.73148  0.482537   0.5724   467   3705.62  59.16  500
3     10    2    4    6  230.03  125.79  221.27   42.961  1.09630  2.71348  0.472824   0.4537   304   1683.47  39.74  500
3     11    1    5    7   56.78  155.03  153.24   42.762  0.86288  2.83463  0.326822   0.3908    70    318.44  17.05  500
3     12    1    7    7   78.37   21.15  154.29   43.126  1.00538  3.00106  0.329010   0.3414    64    183.18  12.69  500
3     13    0    0    0  116.88  237.71  146.04   43.038  0.87482  2.64233  0.311320   0.3675    41    263.72  15.51  500
3     14    0    0    0  215.04  193.77  145.90   43.025  1.02900  2.62863  0.311027   0.3160    40     89.85   8.87  500
3     15    2    6    8  165.16   96.93  153.98   42.605  1.04006  2.81098  0.328453   0.3305    38    142.32  11.25  500
0 NRUN DETNUM    CHI    PHI  OMEGA MONCNT
1 1172      3  45.00  20.00 120.00 100000
2   SEQN    H    K    L     COL     ROW    CHAN       L2  2_THETA       AZ       WL        D   IPK      INTI   SIGI RFLG
3     16    2    2    4   85.22  211.04  366.86   45.863  1.19409  2.49874  0.784112   0.6974  3413  24805.11 154.16  500
3     17    3    3    5  187.21  123.13  309.43   45.646  1.37503  2.51960  0.661098   0.5209   684   6927.36  81.05  500
3     18    4    4    6  236.69   67.68  262.16   46.142  1.47178  2.54317  0.559624   0.4169   494   2145.18  44.99  500
3     19    3    5    7   31.37   77.70  204.13   46.001  1.24077  2.69922  0.435306   0.3744   133    641.68  24.10  500
3     20    4    4    8   86.13  210.18  184.25   45.854  1.19575  2.49903  0.392752   0.3489    94    364.28  17.97  500
```

Lessons Learned

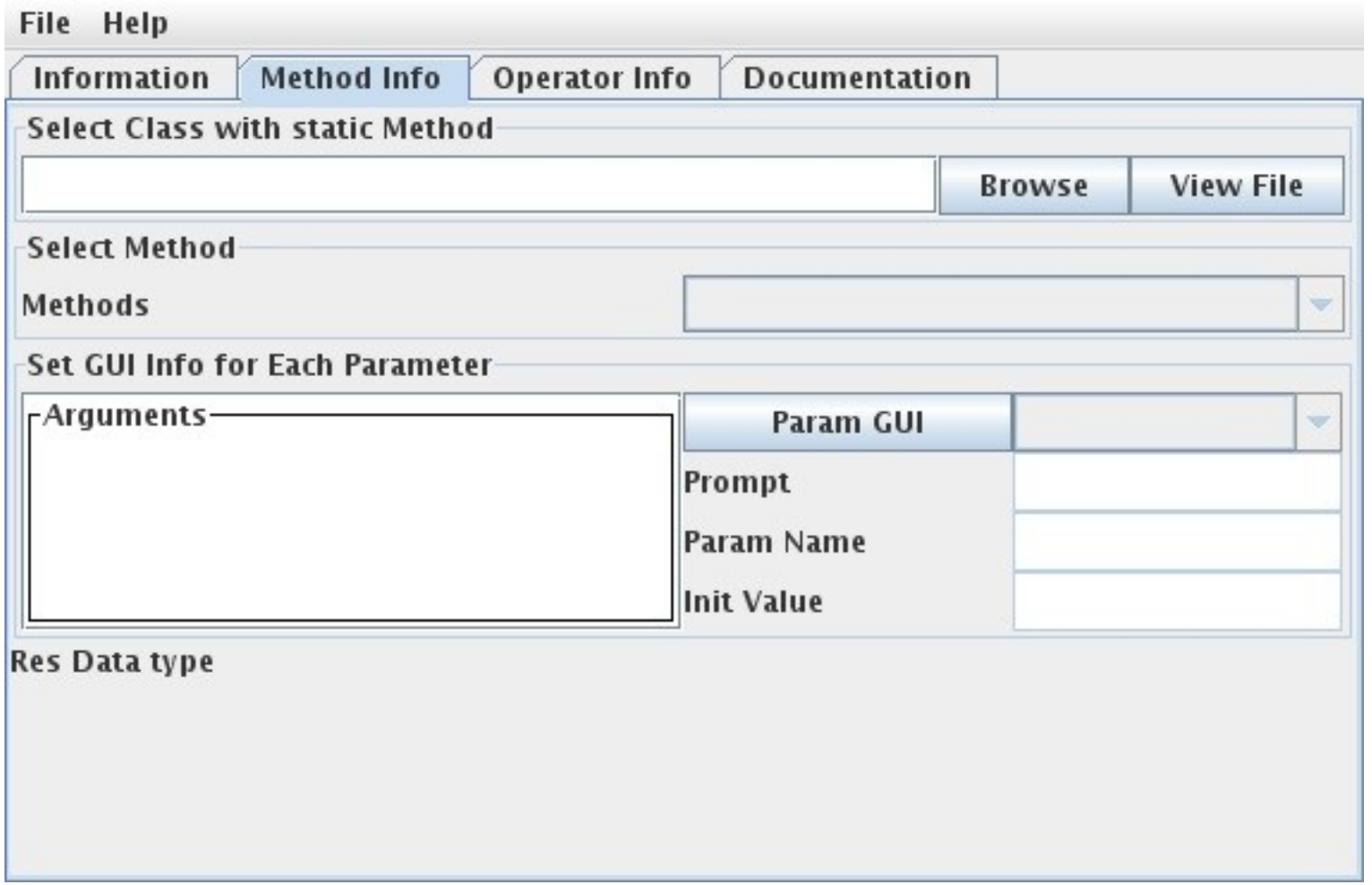
Highly interactive viewers are extremely useful

Loosely coupled message based architecture worked well in IsawEV

For maximum reuse put core calculations in simple subroutine libraries!

Good:	Operators (provide interface with ISAW GUIs & Scripts)
Better:	Wrapped Operators (have calculate method, inherit other methods)
Better Yet:	“Operator Core” with operator itself auto generated from static methods (still uses specialized data structures)
Best:	“Operator Core Core” Provide low-level static method(s) in terms of simple data & arrays Allows easy reuse by other software!!!

Method to Operator Wizard



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SNS Scientific Software Group

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SNS Instrument Teams

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Our Students